FM-704A EMI Filter and Transient Suppression Moudule

16 TO 40 VOLT INPUT - 40 WATT

FEATURES

- Active transient suppression
- Undervoltage lockout
- -55°C to +125°C operation
- 16 to 40 volt input
- Up to 60 dB attenuation at 500 kHz.
- Inhibit function
- Meets MIL-STD-461A-C CE03
- Compatible with MIL-STD-704 A-E dc voltage transient surges

FM-704A	
INPUT (V)	POWER (W)
16 to 40	40

DESCRIPTION

The Interpoint™ FM-704A™ EMI filter and transient suppression module combines EMI filtering and transient protection to handle the demanding requirements of military, aerospace and industrial applications. As an EMI filter the FM-704A filter reduces the reflected ripple current from DC-DC switching converters. As a protection module, it suppresses input transients on the power bus to protect the converter and other downstream components. These filters are designed for use in 28 volt applications which must meet MIL-STD-461 levels of conducted emissions. The filters meet all the requirements of MIL-STD-461C CE03 and CS01 and of MIL-STD-461D, E and F CE102 and CS101 levels of conducted emissions.

MIL-STD Noise Management

When used in conjunction with Interpoint converters, the FM-704A EMI filter reduces reflected input ripple current by a minimum of 60 dB at 500 kHz and 55 dB at 1 MHz. See Table 6 on page 5 and Figures on page 6. This attenuation gives the converter/ filter combination performance exceeding MIL-STD-461C's CE03 test. Although the FM-704A filter effectively attenuates the ripple generated by switching converters, it will not suppress RF applied to its input terminals.

Temperature Operation

FM-704A filters are rated to operate from -55°C to +125°C baseplate temperature. To meet MIL-STD-1275A and MIL-STD-704A requirements, derate output power linearly from 40 watts at 105°C to 20 watts at 125°C. See Figure 10 on page 6.

Protection

To provide protection for itself and converters, the FM-704A filter blocks transients as required by the following standards:

MIL-STD-704A	Panavia SP-P-90001
MIL-STD-461A through F	British Standard BS3G100
MIL-STD-1275	Civil Aircraft D0160B

Refer to the Table 6 on page 5 for more information.

Reverse polarity spikes of up to 100 volts will not damage the filter, however the spikes will not be blocked by the filter.

Internal Power Dissipation

To keep internal power dissipation to safe operating levels, the input current should never exceed 2.5 amps at 16 Vin or 1.0 amp at 40 Vin. When the FM-704A filter is used with pulse width modulated (PWM) converters, I_{LINE} will vary as Power / V_{LINe} and 2.5 amps maximum at 16 Vin will reduce to approximately 1 amp maximum at 40 Vin. The maximum value allowed may be less than 1 amp as determined by line transients and the safe operating area of Figure 10 on page 6.

Figure 10 illustrates the maximum allowed internal dissipation for the FM-704A filter. To calculate watts dissipated, subtract 40 volts from the transient (V_T) to determine the maximum voltage across the filter and multiply the result by the current (the filter's output power, P_{OUT} divided by 40): $W = (V_T - 40) \times P_{OUT} /40$. For example, with 20 watts output and a transient of 400 volts:
$W = (400 - 40) \times 20/40 = 180$

The curve of Figure 10 shows that 180 watts can be dissipated for up to 4 milliseconds.

Features

The inhibit function allows the FM-704A filter to be used as a high-side switch. When the inhibit terminal (pin 6) is left open or pulled high, the FM-704A filter is enabled. When the terminal is grounded, the filter shuts off output power.

A soft start function helps reduce inrush current and start-up overshoot when the filter is initially powered or when it is released from the inhibit mode.

An undervoltage lockout feature shuts off output power when input voltage falls below a specified level. Refer to Figure 7 for more information.

Layout Requirements

To minimize EMI common mode noise, the case of the filter must be connected to the case of the converter through a low impedance connection.

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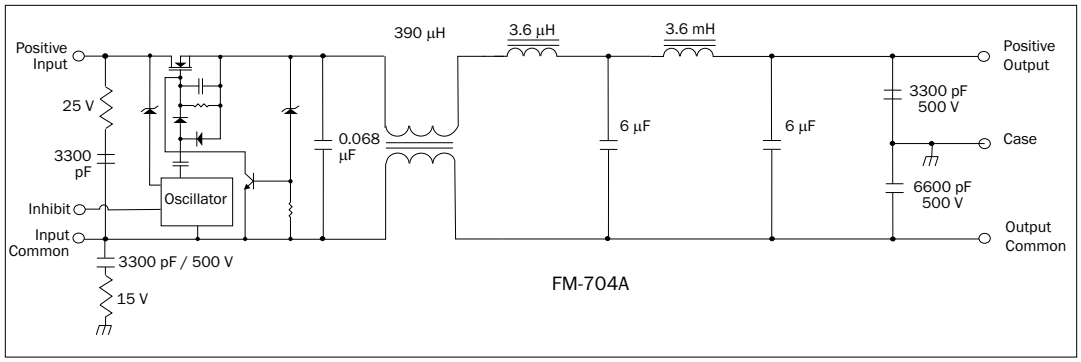


The case ground connection between the filter and the converter should be as low an impedance as possible to minimize EMI. Direct contact of the baseplate to chassis ground provides the lowest impedance.

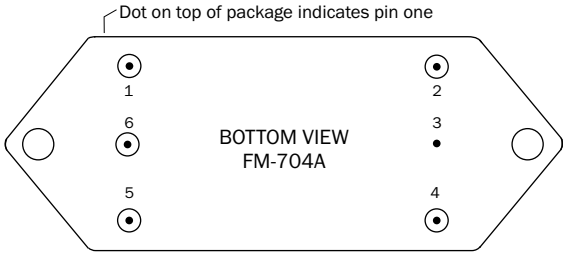
FIGURE 1: SCHEMATIC – TYPICAL VALUES

PIN OUT	
Pin	**Designation**
1	Positive Input
2	Positive Output
3	Case Ground
4	Output Common
5	Input Common
6	Inhibit

TABLE 1: PIN OUT

PINS NOT IN USE	
Inhibit	Leave unconnected

TABLE 2: PINS NOT IN USE



See Figure 11 on page 7 for dimensions.

FIGURE 2: PIN OUT

FM-704A EMI Filter and Transient Suppression Moudule

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MODEL NUMBERING KEY

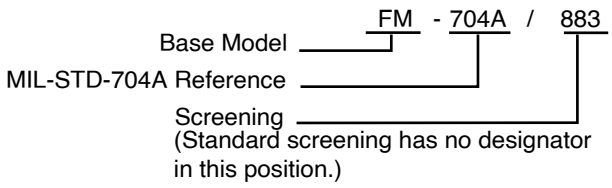

FIGURE 3: MODEL NUMBERING KEY

DLA NUMBERS	
DLA DRAWING (5915)	**FM-704A SIMILAR PART**
94028-01HXC	FM-704A/883
For exact specifications for a DLA product, refer to the DLA drawing. DLA drawings can be downloaded from: https://landandmaritimeapps.dla.mil/programs/smcr	

TABLE 3: DLA DRAWING CROSS REFERENCE.

MODEL NUMBER OPTIONS [1] TO DETERMINE THE MODEL NUMBER ENTER ONE OPTION FROM EACH CATEGORY IN THE FORM BELOW.		
CATEGORY	**Base Model**	**Screening [2]**
OPTIONS	FM-704A	Standard (leave blank) ES 883 (Class H)
FILL IN FOR MODEL # [3]	FM-704A /	_____

Notes:
1. See Model Numbering Key above for an example of a model number.
2. Screening: For standard screening leave the screening option blank. For other screening options, insert the desired screening level. For more information see Table 5 on page 4 and Table 8 on page 9.
3. If ordering by model number add a "-Q" to request solder dipped leads (FM-704A/883-Q).

TABLE 4: MODEL NUMBER OPTIONS

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TABLE 5: OPERATING CONDITIONS 25°C CASE, 28 VIN, UNLESS OTHERWISE SPECIFIED

MODEL		FM-704A			
PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
LEAD SOLDERING TEMPERATURE [1]	10 seconds max.	—	—	300	°C
STORAGE TEMPERATURE [1]		-65	—	+150	°C
CASE OPERATING TEMPERATURE [1]	40 W	-55	—	+105	°C
	20 W	—	—	+125	
DERATING OUTPUT POWER/CURRENT [1]	LINEARLY TO MEET MIL-STD-1275A (AT) AND MIL-STD-704A	From 40 W at 105°C to 20 W at 125°C			
ISOLATION [2]	500 VDC AT 25°C	100	—	—	Megohms

Notes
1. Guaranteed by characterization test and/or analysis. Not a production test.
2. Tested with all pins, except case pin 3, tied together. When testing isolation, discharge the pins before and after testing.

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TABLE 6: ELECTRICAL CHARACTERISTICS: -55°C TO +125°C CASE, UNLESS OTHERWISE SPECIFIED.

MODEL			FM-704A			
PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
INPUT VOLTAGE [1]	NO LOAD		0	28	40	V
	40 WATT LOAD TO 105°C T_C		16 [1]	28	40 [1]	
	UNDER VOLTAGE LOCKOUT		7	—	—	
INPUT CURRENT	16 V_{IN} [1]		–	–	2.5	A
	40 V_{IN} [1]		–	–	1.0	
	NO LOAD		–	–	5	mA
	INHIBITED		–	–	2	
INPUT SURGE	40 W, 100 V, 0.5 Ω Z_S, 60 ms [2]		40	–	50	V_{OUT}
INPUT SPIKE, TO 105°C T_C	40 W, 400 V, 0.5 Ω Z_S, 5 ms [3]		–	–	50	V_{OUT}
	40 W, 600 V, 50 Ω Z_S, 10 ms [1, 4]		–	–	50	
DIFFERENTIAL MODE NOISE REJECTION	500 kHz		60	–	–	dB
	1 MHz		55	–	–	
DC RESISTANCE (R_{DC}) [1]	T_C = 25°C		–	–	0.45	ohms
OUTPUT VOLTAGE	STEADY STATE		$V_{OUT} = V_{IN} - I_{IN}(R_{DC})$			V
	INHIBITED		–	–	1	
OUTPUT CURRENT	16 V_{IN}		–	–	2.5	A
	40 V_{IN}		–	–	1.0	
INTERNAL POWER DISSIPATION [1]	PEAK	T_C = 105°C	–	–	1000	W
		T_C = 125°C	–	–	500	
	CONTINUOUS (>10 sec)	T_C = 105°C	–	–	30	
		T_C = 125°C	–	–	15	
CAPACITANCE [5]			8.58	–	16.5	nF

Notes
1. Guaranteed by characterization test and/or analysis. Not a production test.
2. Meets MIL-STD-1275A (AT) Surge and Figures 8 and 9 of MIL-STD-704A. For these standards derate output power linearly from 40 watts at 105°C to 20 watts at 125°C.
3. Meets Panavia SP-P-90001, British Standard BS3G100 and Civil Aircraft D0160 Standards.
4. Meets MIL-STD-461C 1.2 CS06 limits.
5. Tested with all pins tied together except case pin.

FM-704A EMI Filter and Transient Suppression Moudule

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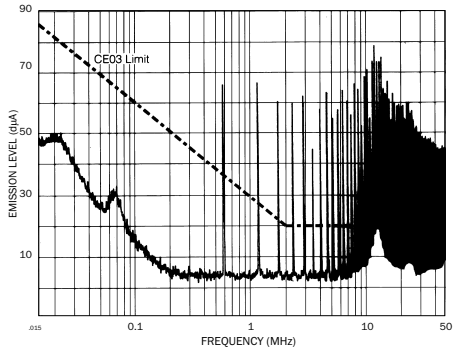
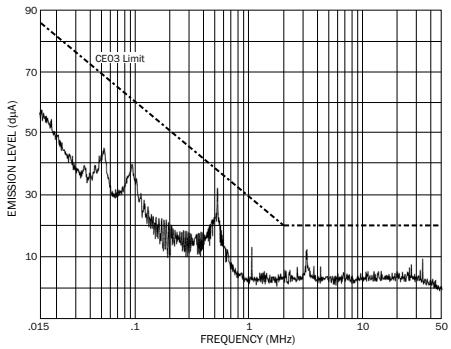
TYPICAL PERFORMANCE PLOTS: 25°C CASE, UNLESS OTHERWISE SPECIFIED.
FOR REFERENCE ONLY, NOT GUARANTEED SPECIFICATIONS.



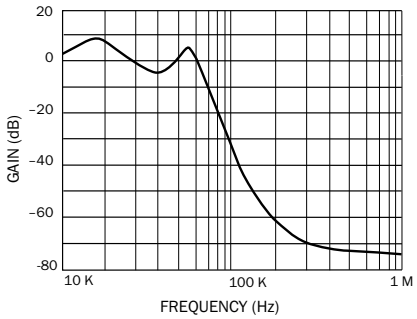
MHF+ Converter without Filter

FIGURE 4



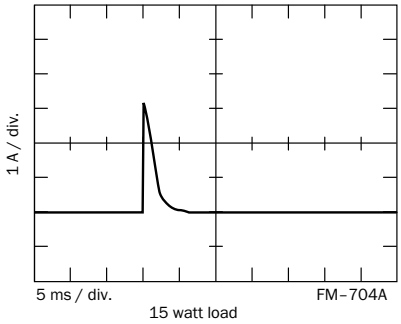
MHF+ Converter with FM-704A Filter

FIGURE 5



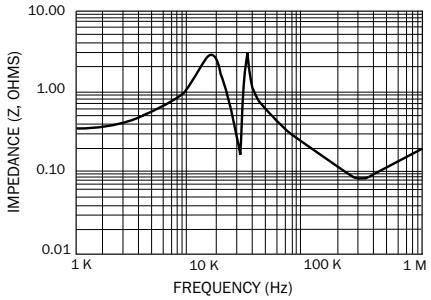
Differential Mode Response

FIGURE 6



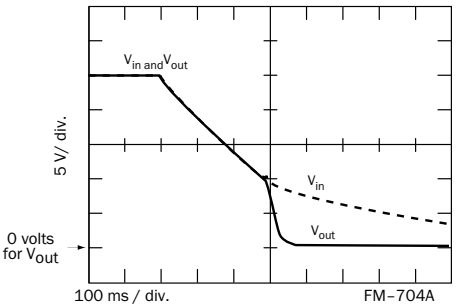
Inrush Current

FIGURE 7



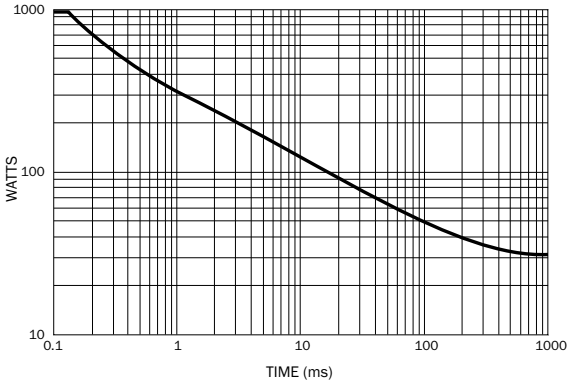
Typical Output Impedance (Z)
With Input Shorted

FIGURE 8



Undervoltage Lockout

FIGURE 9



Derate power linearly to 50% at 125°C. Operation below this curve ensures a maximum junction temperature rise of 40°C or less.

Maximum Allowed Internal Power Dissipation
105°C case temperature

FIGURE 10

FM-704A EMI Filter and Transient Suppression Moudule

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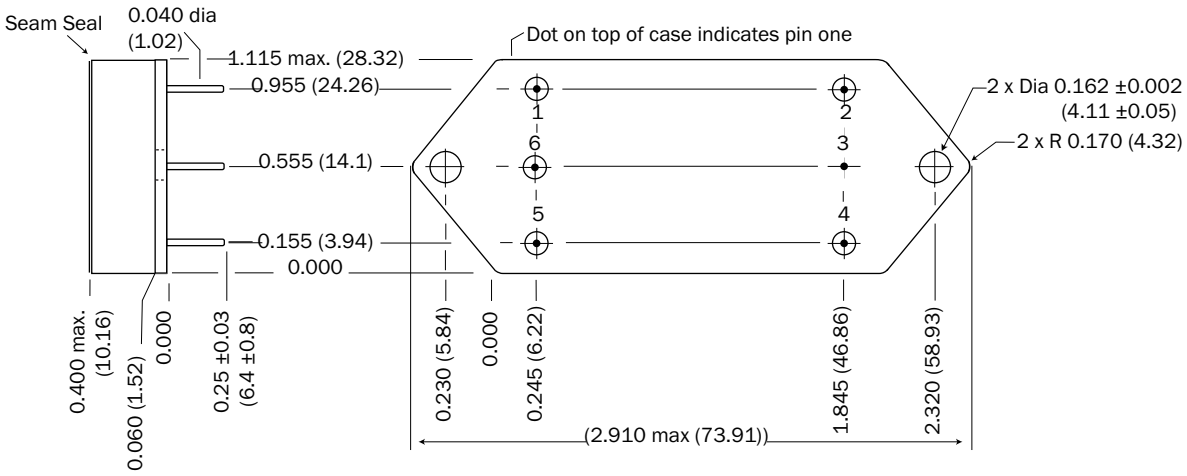
BOTTOM VIEW CASE K1



Case dimensions in inches (mm)
Tolerance ±0.005 (0.13) for three decimal places
±0.01 (0.3) for two decimal places
unless otherwise specified

CAUTION
Heat from reflow or wave soldering may damage the device. Solder pins individually with heat application not exceeding 300°C for 10 seconds per pin.

Materials

Header	Cold Rolled Steel/Nickel/Gold
Cover	Kovar/Nickel
Pins	#52 alloy/Gold ceramic seal.
	Seal Hole: 0.120 ±0.002 (3.04 ±0.05)

Please refer to the numerical dimensions for accuracy.

FIGURE 11: CASE K1

FM-704A EMI Filter and Transient Suppression Moudule

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ELEMENT EVALUATION [1] HIGH RELIABILITY DC-DC CONVERTERS AND EMI FILTERS /883 (CLASS H)

COMPONENT-LEVEL TEST PERFORMED	QML CLASS H /883 M/S [2]	QML CLASS H /883 P [3]
Element Electrical	■	■
Visual	■	■
Internal Visual	■	
Final Electrical	■	■
Wire Bond Evaluation	■	■

Notes
1. Element evaluation does not apply to standard and /ES product.
2. M/S = Active components (microcircuit and semiconductor die).
3. P = Passive components, Class H element evaluation. Not applicable to standard and /ES element evaluation.

TABLE 7: ELEMENT EVALUATION

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ENVIRONMENTAL SCREENING HIGH RELIABILITY DC-DC CONVERTERS AND EMI FILTERS STANDARD, /ES AND /883 (CLASS H)

	NON-QML [1]		QML [2]
TEST PERFORMED	**STANDARD**	**/ES**	**/883**
Pre-cap Inspection, Method 2017, 2032	■	■	■
Temperature Cycle (10 times)			
Method 1010, Cond. C, -65°C to +150°C, ambient			■
Method 1010, Cond. B, -55°C to +125°C, ambient		■	
Constant Acceleration			
Method 2001, 3000 g			■
Method 2001, 500 g		■	
PIND, Test Method 2020, Cond. A			■ [3]
Burn-in Method 1015, +125°C case, typical [4]			
96 hours		■	
160 hours			■
Final Electrical Test, MIL-PRF-38534, Group A,			
Subgroups 1 through 6, -55°C, +25°C, +125°C case			■
Subgroups 1 and 4, +25°C case	■	■	
Hermeticity Test, Method 1014			
Gross Leak, Cond. C_1, fluorocarbon		■	■
Fine Leak, Cond. A_2, helium		■	■
Gross Leak, Dip	■		
Final visual inspection, Method 2009	■	■	■

Test methods are referenced to MIL-STD-883 as determined by MIL-PRF-38534.

Notes
1. Non-QML products may not meet all of the requirements of MIL-PRF-38534.
2. All processes are QML qualified and performed by certified operators.
3. Not required by DLA but performed to assure product quality.
4. Burn-in temperature designed to bring the case temperature to +125°C minimum. Burn-in is a powered test.

TABLE 8: ENVIRONMENTAL SCREENING